

OBSERVATIONAL APPROACHES TO THE TOPOLOGY OF THE UNIVERSE

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Many different and complementary strategies for translating the basic principle of multiple topological imaging into observational analysis are now available, both for three-dimensional and two-dimensional catalogues.

1 Introduction

Observational cosmic topology^{13,17} shares the fundamental observational problems of curvature estimates (evolution of objects, peculiar velocities, etc., see Section 5.3 of ref.¹⁷), but since the former concerns global geometry and the latter only local geometry, the former requires additional work in classifying the methods from a purely geometrical point of view. Most work is based on the principle of the existence of multiple topological images of single physical objects.

2 Complementary geometrical strategies

A. multiple topological images:

A.i three-dimensional (collapsed astrophysical objects):

A.i.1 local isometries^{18,24,25} - multiple occurrence of “type I pairs” or “local pairs”

A.i.2 cosmic crystallography^{15,16,8,6,7,9,10,24,25} - multiple occurrence of “type II pairs” or “generator pairs”, i.e. of pairs of objects in co-moving space separated by a generator

- for comparison, the uncorrelated pairs from simply connected random simulations could be called “type III pairs” or “random pairs”

A.i.3 characteristics of individual objects^{11,22,26}

A.ii two-dimensional (microwave background, CMB):

A.ii.1 identified circles principle: discovery of principle^{4,5} and its quantitative application to COBE data^{19,21}

A.ii.2 patterns of spots¹⁴

A.ii.3 perturbation statistics assumptions: see refs listed under (i) in Section 1.2 of ref.¹⁹; controversy against² and in favour of^{12,1,3} hyperbolic compact 3-manifolds by applying these assumptions to COBE data remains

B. other:

B.i cosmic strings²³

B.ii nested crystallography²⁰

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